

## Application of Food Waste Compost on Soil Microbial Population in Groundnut Cultivated Soil, India

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**Abstract:** Organic agriculture promotes the production of non toxic food in the world. In the present investigation was made to find out application of food waste compost on soil microbial population. Soil microbes enhance the nutrition in the soil and take care the crop growth and improve the soil fertility. Soil microbes solubilize the insoluble status of elements present in the soil. In the present study findings is bacterial, fungal population and microbial biomass improves the addition of food waste compost in groundnut cultivated soil. The microbial load of the soil utilizes the carbon sources and also enhances the microbial biomass when the soil turned in to addition of food waste compost.

**Key words:** Organic agriculture • Microbial load • Groundnut • Food waste compost

### INTRODUCTION

Sustainable agriculture emphasizes the conservation of its own resources. For a farm to be sustainable, it must produce adequate amounts of high quality foods, be environmentally safe and where appropriate, be profitable. Sustainable farms minimize their purchased inputs (fertilizers, energy and equipment) and rely, as much as possible on the renewable resources of the farm itself. This is especially important in the 90 per cent of farms that exist in the third world, where there inputs are often not available or affordable. Green revolution in India was mainly realised with the introduction of high yielding varieties of various crops and by following intensive cultivation practices with the use of fertilizers, pesticides and other inputs. The fertilizer consumption in the country accordingly has increased from 66,000 tonnes in 1951-52 to about 12.16 million tonnes in 1992-93. In other terms, fertilizer consumption which was only 0.5 kg/ha in 1951-52, increased to 67 kg during 1992-93. Same was the situation with pesticides. All these agro chemicals are produced from non-renewable fossil fuel. In future, diminishing availability of these inputs may not only cost heavily on our foreign exchange but may also limit

agricultural production. In India, an abundant food culture has resulted in production of large amounts of food wastes corresponding to approximately 40% of the total amount of garbage produced every year [1]. Food wastes produced have mainly been dumped in land fill sites or burnt. When they are buried and fill of food wastes have created various problems such as putrid smell and contaminated ground and surface water [2]. The disposal of waste by incineration has been avoided due to the enormous costs of construction and working of incineration facilities and environmental problems like discharge of harmful gas and toxic ashes. There has been much discussion on the effect of organic fertilizer and waste compost from pig manure [3, 4] and sewage sludge [5, 6] on soil properties and crop quality as well as optimum application rate. However, little research has been done on the effect of food waste in relation to soil microbial population, enzyme activity and plant growth.

The objective of this study was to examine the effect of food waste compost on change on soil microbial population, soil enzyme activity and groundnut growth in relation to sodium content and release from compost in soil environment.

## MATERIALS AND METHODS

Groundnut (*Arachis hypogaea* L.) seeds were placed in multi cell flats (plug trays) filled with medium (1 kg for each cell), germinated and raised in a greenhouse. The nursery medium was purchased from Tamil Nadu Agricultural University, Coimbatore. Three weeks after planting, groundnut seedlings were transplanted to pots containing 5 kg of soil amended with mineral fertilizer, commercial compost, or food waste compost. Every two weeks after transplanting, plant growth characteristics, microbial populations and enzyme activities were analyzed. In this study, treatments were as follows: MF (Mineral fertilizer: N 15 kg, P<sub>2</sub>O<sub>5</sub> 8.85 kg, K<sub>2</sub>O 9.6 kg/10a); CC (commercial compost: 1800 kg 110a); FW 0.5 (food waste composted with MS: 900 kg 100a); FW 1.0 (food waste composted with MS: 1800 kg 110a), FW 1.5 (food waste composted with MS: 2700 kg 110a and CON (control). The commercial compost was purchased from Saratha Vermiculite Co. Ltd., Erode. The commercial compost was comprised of 30% animal slurry 30% plant residue, 30% sawdust and 10% vermiculite, which was composted aerobically for four months. The food waste compost was prepared in our laboratory as follows. One hundred kilograms of fresh food waste was gathered from restaurants, mixed with 0.5 kg miraculous soil microorganisms (Agricultural Microbiology Department, Tamil Nadu Agricultural University, Coimbatore) and then composted aerobically for one year. The chemical properties of nursery medium and commercial and food waste compost are shown in Table 1.

Microbial population of the rhizosphere soil was enumerated by the soil dilution plate method [7]. Tryptic soy agar and rose Bengal agar were used for bacteria and fungal counts, respectively. To suppress fungi, cycloheximide (50 ppm) was added to tryptic soy agar and rose Bengal agar was supplemented with streptomycin (30 ppm) to inhibit bacterial growth.

The equivalent of 20 g of soil was placed into a 120 ml cup and adjusted to 30% moisture on a dry weight base. Samples were either fumigated with CHCl<sub>3</sub> under vacuum in the dark at 25°C for 24h or were not fumigated. After this period, chloroform contained in the soil was removed by repeated evacuation. Fumigated soil was mixed well. A 5 ml vial containing 1 ml of 2 N NaOH was placed in each beaker containing a soil sample. The beakers were sealed and then incubated for 10 days at 25°C. Soil microbial carbon was calculated as the difference between the carbon content of fumigated and unfumigated samples with a mineralization constant (Kc) of 0.41 [8]. Analysis of variance was performed using the SAS version 6.05. The least significant differences (LSD) among mean values were calculated at  $p < 0.05$  confidence level.

## RESULTS

As shown in Table 2 and 3, population of fungi and bacteria in the rhizospheres of FW treatments (FW 0.5, FW 1.0 and FW 1.5) were significantly higher than those in CON, CC and MF treatments at 2, 4, 6 weeks after transplanting. The populations of fungi in FW treatments were about 30-500 times higher than those in CON,

Table 1: Chemical properties of nursery medium, commercial and food waste compost

Treatments	T-N (%)	OM (%)	C/N	K (g kg <sup>-1</sup> )	Ca (g kg <sup>-1</sup> )	Mg (g kg <sup>-1</sup> )	Na (g kg <sup>-1</sup> )
NM	0.30	29.5	56.75	6.04	14.78	9.73	3.74
FW	3.78	56.8	12.02	3.23	52.35	2.64	5.24
CC	0.67	25.4	37.56	6.95	39.64	45.47	1.19

NM: nursery medium; FW: food waste compost; CC: commercial compost

Table 2: Population of fungi in rhizosphere of groundnut in pots as affected by commercial compost (CC), mineral fertilizer (MF) and different amounts of food waste compost (FW 0.5, FW 1.0, FW 1.5). Means with the same letters are not significantly different at  $p < 0.05$  when compared by LSD. Treatment means are the average of three replicates

Duration	CON	CC	MF	FW 0.5	FW 1.0	FW 1.5
Log CFU g <sup>-1</sup> soil						
2 weeks	4.21 <sup>a</sup>	5 <sup>c</sup>	5.25 <sup>d</sup>	6.91 <sup>abc</sup>	7.01 <sup>a</sup>	7.05 <sup>a</sup>
4 weeks	4.54 <sup>ab</sup>	4.75 <sup>cd</sup>	4.79 <sup>cd</sup>	6.50 <sup>c</sup>	6.52 <sup>bc</sup>	7.10 <sup>a</sup>
6 weeks	4.56 <sup>ab</sup>	4.80 <sup>cd</sup>	4.94 <sup>c</sup>	6.90 <sup>ab</sup>	6.92 <sup>ab</sup>	7.07 <sup>a</sup>

Table 3: Population of bacteria in rhizosphere of groundnut in pots as affected by commercial compost (CC), mineral fertilizer (MF) and different amounts of food waste compost (FW 0.5, FW 1.0, FW 1.5). Means with the same letters are not significantly different at  $p < 0.05$  when compared by LSD. Treatment means are the average of three replicates

Duration	CON	CC	MF	FW 0.5	FW 1.0	FW 1.5
Log CFU g <sup>-1</sup> soil						
2 weeks	6.48 <sup>a</sup>	6.75 <sup>bc</sup>	7.25 <sup>d</sup>	7.90 <sup>c</sup>	7.94 <sup>c</sup>	8.30 <sup>b</sup>
4 weeks	6.40 <sup>ab</sup>	6.84 <sup>cd</sup>	7.10 <sup>de</sup>	7.85 <sup>c</sup>	8.10 <sup>bc</sup>	8.35 <sup>b</sup>
6 weeks	6.70 <sup>ab</sup>	6.90 <sup>cd</sup>	6.80 <sup>cd</sup>	8.25 <sup>bc</sup>	9.00 <sup>a</sup>	9.27 <sup>a</sup>

Table 4: Microbial biomass in rhizosphere of groundnut in pots as affected by commercial compost (CC), mineral fertilizer (MF) and different amounts of food waste compost (FW 0.5, FW 1.0, FW 1.5). Means with the same letters are not significantly different at  $p < 0.05$  when compared by LSD. Treatment means are the average of three replicates

Duration	CON	CC	MF	FW 0.5	FW 1.0	FW 1.5
Log CFU g <sup>-1</sup> soil						
2 weeks	0.18 <sup>i</sup>	0.38 <sup>efgh</sup>	0.29 <sup>hi</sup>	0.41 <sup>efgh</sup>	0.50 <sup>def</sup>	0.55 <sup>cde</sup>
4 weeks	0.33 <sup>gh</sup>	0.52 <sup>def</sup>	0.44 <sup>efg</sup>	0.69 <sup>c</sup>	0.91 <sup>ab</sup>	1.00 <sup>a</sup>
6 weeks	0.39 <sup>gh</sup>	0.61 <sup>cd</sup>	0.51 <sup>def</sup>	0.68 <sup>c</sup>	0.82 <sup>b</sup>	0.86 <sup>ab</sup>

CC and MF treatments throughout the growing period. There was no significant difference in fungal population among FW treatments although it was slightly low in FW 0.5 and FW 1.0 at 4 weeks. The population of bacteria in FW treatments at 2, 4, 6 weeks was about 5-400 times higher than those in CON, CC and MF treatments and the highest population of bacteria was observed in FW 1.0 and FW 1.5 at 6 weeks. Soil biomass in FW treatments was generally higher than that in CON, CC and MF treatments at 2, 4, 6 weeks (Table 2-4). The highest biomass was found in FW 1.5 at 4 weeks.

### DISCUSSION

It is known that organic matter introduced to soil stimulates soil microbial populations and soil biological activity [9]. The addition of compost to soil increased the incidence of bacteria in the tomato rhizosphere [10]. The number of colony forming units of bacteria and fungi increased when pig manure compost was added to the soil [3]. Increased soil biological activity and microbiological growth were also reported when vermicompost of sewage sludge was added, where sewage enhanced soil microbial biomass by 8-28% [11, 12].

The organic fraction of food waste compost was mostly comprised of the remains of fruit and vegetables with high carbohydrate content and it was early used as carbon and energy source by microorganisms [13]. As shown in Table 1 food waste compost contained not only high carbon content but also high nitrogen content.

The carbon and nitrogen in food waste compost could be easily used as energy and nutrient source for soil microorganisms and this resulted in increased soil microbial populations and soil biomass. There are in the agreement with results obtained by that the addition of organic amendments increased the microbial biomass and resulted in a positive correlation between microbial biomass C and soil microbial populations [11, 14]. Food waste compost could be an alternative to chemical fertilizer to increase soil microbial populations and improving the for groundnut growth.

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